(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number : **0 494 053 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number : **91830578.0**

(51) Int. Cl.[5] : **E04H 15/20**

(22) Date of filing : **20.12.91**

(30) Priority : **31.12.90 IT 956190**
10.09.91 IT 22191

(43) Date of publication of application :
08.07.92 Bulletin 92/28

(84) Designated Contracting States :
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

(71) Applicant : **EUROVINIL INDUSTRIES S.p.A.**
Via Genova n.3
I-58100 Grosseto (IT)

(72) Inventor : **Giachi, Franco**
Via Ximenes n. 41
I-58100 Grosseto (IT)

(74) Representative : **Mannucci, Gianfranco, Dott.-Ing.**
Ufficio Tecnico Ing. A. Mannucci Via della Scala 4
I-50123 Firenze (IT)

(54) Construction in the form of a shed or hangar with a pneumatic supporting structure.

(57) A construction in the form of a shed or hangar for the protection and maintenance of aircraft and similar, comprises a pneumatic supporting structure having a plurality of supporting arches (3) consisting of inflatable tubular members connected together by means of connecting members (5).

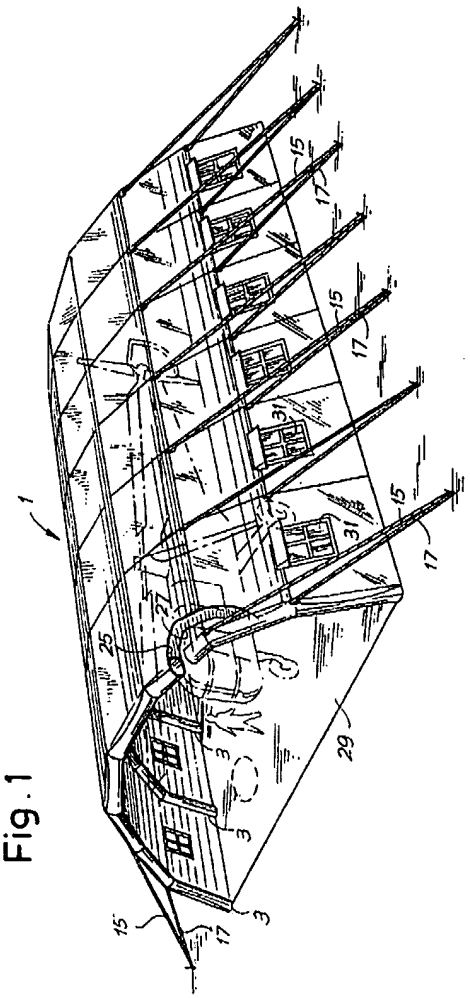


Fig.1

EP 0 494 053 A1

The invention relates to a construction in the form of a hangar or shed for the protection of aircraft or similar and for their maintenance or for the storage of goods or other items.

It is frequently necessary to use aircraft, such as airplanes or helicopters, in areas without housing structures for the protection of the aircraft and for the performance of the maintenance operations. This occurs, for example, in the case of operations in areas that have had natural disasters or similar. It is frequently the case that these areas are excessively remote from structures suitable for the accommodation of the aircraft and are not conveniently equipped for the performance of maintenance operations.

The object of the invention is the provision of a construction of the type mentioned above which may easily be assembled and dismantled in a short time and without the necessity of civil engineering work such as the provision of foundations or similar, thus enabling the construction to be erected even in areas lacking in infrastructure and with a small amount of manpower. The object of the invention also includes the provision of a light structure which may easily be dismantled and may also be transported by means of helicopters.

These and other objects and advantages, which will appear evident to experts in this field from the reading of the following text, are attained with a construction in the form of a shed or hangar for the protection and maintenance of aircraft and similar, comprising a pneumatic supporting structure having a plurality of supporting arches consisting of inflatable tubular members connected together in the longitudinal direction by means of connecting members which may also be pneumatic and inflatable. By using pneumatic inflatable connecting members it is possible to obtain high resistance to external loads such as wind, snow and similar. Additionally, by using a completely pneumatic skeleton it is possible to raise and assemble the whole structure more easily.

A covering sheet may be disposed above the pneumatic supporting structure and if necessary a thermally insulating sheet beneath it. This makes the structure waterproof and also, if necessary, thermally insulated.

The structure may be appropriately accompanied by wind-bracing formed by a plurality of guys or stays anchored at one end to the arches of the pneumatic structure and at the other end to the ground by means of stakes or similar.

The arches of the pneumatic structure may also be depressed arches, each accompanied by a horizontal stay or tie which in turn is connected to the wind-bracing system external to the structure with a special rigid stay inside the pneumatic column. These stays have the function of transferring the tensile stress from the tie or stay to the external wind-bracing guys.

The connecting tubular members which connect the various arches of the structure in the longitudinal direction may be coupled to the corresponding arches by means of joints and also, if necessary, with a pneumatic connection, so that they may be inflated together with and simultaneously with the corresponding arches.

In order to facilitate the transportation of the construction, the supporting structure may be divided into sections, each of which comprises one or more supporting arches and the associated tubular longitudinal connecting members, each section being pneumatically independent of the adjacent section or sections.

Each section of the supporting structure may be associated with at least one safety valve to counter excess internal pressure on the structure, and the said valve may advantageously discharge to the outside of the construction any excess pressure due to temperature variations.

The supporting pneumatic structure may be associated with a system for monitoring and maintaining the internal pressure of the members of the structure, the said system comprising pressure sensing means and compressor means which have the function of compensating for any pressure losses due to sudden temperature changes or other causes.

Further advantageous characteristics of the structure according to the invention are indicated in the attached claims.

The invention will be more clearly understood by following the description and the attached drawing which shows a non-restrictive example of embodiment of the invention. In the drawing,

Fig. 1 is an external perspective view of the construction according to the invention;

Figs 2 and 3 are schematic front views of two examples of embodiment;

Fig. 4 is a side view from IV-IV in Fig. 3;

Fig. 5 is an enlargement of the detail relating to the system of connection between supporting arches and the pneumatic longitudinal connecting members;

Fig. 6 is an enlargement of detail VI in Fig. 2;

Fig. 7 shows the arrangement of the pre-tensioning base stays of the pneumatic arches;

Fig. 8 shows a first embodiment of the means of joining two covering sheets;

Fig. 9 is a local transverse section through IX-IX in Fig. 8;

Fig. 10 shows a second embodiment of the means of joining two covering sheets;

Fig. 11 is a local transverse section through XI-XI in Fig. 10;

Fig. 12 shows a system of anchoring the covering sheet to the ground; and

Figs 13 through 15 show-a-wind-bracing system for the front walls.

The construction, indicated in general by 1, has a

supporting structure formed by a plurality of arches 3, each of which is formed by a pneumatic tubular member of suitable section. The various arches 3 formed by the pneumatic tubular members are connected together by means of tubular connecting members 5 disposed at suitable points along the length of the arches. In the example of embodiment shown in the attached drawing, there are disposed at intervals between two consecutive arches three tubular connecting members 5, one central, at the top of the arch, and two lateral. The tubular connecting members provide longitudinal wind- bracing for the structure.

As shown in the enlargement in Fig. 5, each tubular connecting member 5 is connected at its ends to the corresponding adjacent arches 3 by means of a system of connecting joints 7, providing the mechanical connection. In addition to said joint system, the tubular connecting members 5 are pneumatically connected to the arches 3 by means of a line 9 which enables the arches 3 and the corresponding tubular connecting members 5 to be inflated simultaneously. More particularly, the joint system comprises four joints 7, each of which has two studs 6, formed with eyes 6A, integral with one of the members to be connected, and one stud 8, with an eye 8A, integral with the other of the two members to be connected. The connection is made with a screwed pivot 10. Each stud is welded or glued to the associated tubular member.

As may be seen in Figs 2 and 3, the arches 3 of the pneumatic supporting structure may have various configurations. In particular, Fig. 2 shows a structure with a depressed arch, while Fig. 3 shows a structure with a raised arch. Wind-bracing elements, formed by guys, indicated by 11 and 13 in the embodiment in Fig. 2 and by 15 and 17 in the embodiment in Fig. 3, are disposed on the outside of the arches. In the configuration in Fig. 2 with depressed arches, each arch 3 is accompanied by a horizontal tie or stay 19, which mechanically connects the ends of the arch at the point of attachment to the columns, and is anchored to the arch by means of studs 19A. The guys 11 of the external wind-bracing are anchored (by means of welded studs 11A) to the column part of the arches 3 so that they are aligned with stays 21 disposed within the tubular members forming the corresponding arch 3, and are anchored to the internal cylindrical wall of said tubular member at the points of attachment of the guy 11 and of the tie 19 by means of studs 21A and 21B respectively, which are welded to the tubular walls. The system of stays 11, 21, 19 thus forms a structure capable of transferring to the ground the tensile stresses imposed on the system of stays 11, 21 by external stresses, due for example to wind or snow.

The embodiment in Fig. 3, having a non-depressed arch, has no tie 19 or internal stays 21, since the shape of the arch enables the stresses due to accidental overloading to be transferred directly to the base of the arch.

In order to remove the stress at the junction of the voussoirs of the arches 3, a system of pre-tensioning of the arches may be provided. This system is shown schematically in Fig. 7. At the base of each arch are provided stays 24, whose ends are anchored (by means of a system of studs or other system) to the bases of each arch 3. When the structure is inflated, the arches are filled with air under pressure and the stays 24 are stressed, subjecting the corresponding arches 3 to a pre-tensioning flexural stress, with compressive forces on the intrados and tensile forces on the extrados.

A covering sheet indicated by 25 in Fig. 1 is disposed above the supporting structure formed by the tubular members of the arches 3 and by the tubular connecting members 5. A second sheet 27 may be disposed beneath the supporting structure. The outer sheet 25 has the function of waterproofing the interior of the construction and the inner sheet 27 has the function of thermal insulation. A third sheet 29 may be disposed on the floor of the construction to form a barrier to rising damp from the soil and to cover the stays 24. The sheets 25, 27 have apertures forming windows 31 on the lateral surfaces of the construction. The bottom sheet or vault 29 may have apertures with suitable means of closure. These apertures have the function of exposing the underlying soil to enable aircraft to be connected to ground, thus discharging any electrostatic charges which may have accumulated on the aircraft. This may be necessary for reasons of safety, for example before refuelling operations on the aircraft.

The bottom sheet 29 may be connected to the outer sheet 25, for example by means of strips of Velcro® or other systems such as those in Figs 8 and 10.

To permit easy packaging and easy transportation of the various elements forming the structure according to the invention, it is specified that the supporting structure formed by the arches 3 and by the tubular connecting members 5 should be capable of being dismantled into various sections, each of limited weight. For example, two sections may comprise two adjacent arches 3 and six tubular connecting members 5, while the other section comprises another two arches 3 and three tubular connecting members 5.

The covering sheets may also advantageously be divided into a number of parts which may be connected together at the time of assembly of the structure. Systems such as those shown in Figs 8 through 11 may be used for the connection of a number of adjacent parts of the sheet and to prevent water penetration at the joints.

Figs 8 and 9 show a first embodiment of the joining means. 25A and 25B indicate two adjacent parts of the covering sheet 25. The two parts 25A and 25B have abutting edges formed with eyes 41A and 41B spaced at regular intervals and staggered with res-

pect to each other, so that the eyes 41B of the sheet part 25B enter into the spaces between the eyes 41A which are integral with the sheet part 25A. A cable or rope 43 is passed through the eyes 41A, 41B to form a mechanical means of connection between the two sheet parts 25A, 25B. Flaps or strips 43A and 43B extending parallel to the corresponding abutting edges are integral with the two sheet parts 25A and 25B respectively. The strip 43A is single, and carries a strip of Velcro® 45 along its length and on both faces. The strip 43B is double, and each of its two component parts is accompanied with a fabric strip 47 capable of engaging with the Velcro® strips 45 to connect the two strips 43A, 43B in a reversible way. Automatic press studs 49 to couple the strips 43A, 43B are provided in addition to the Velcro®. The sheet part 25A is also associated with a drip element 51 formed by a thin sheet integral with the sheet part 25A, inclined with respect to the latter and extending parallel to the edge of the sheet part 25A over the whole length of the edge. The drip element 51 is positioned in such a way that any water penetrating between the strips 43A, 43B is shed downward along the joint, without passing through the edges of the sheet parts 25A, 25B.

Figs 10 and 11 show a modified embodiment of the joint between the two sheet parts 25A, 25B. Identical numbers indicate parts corresponding to the embodiment in Figs 8 and 9. In this embodiment, the mechanical connection is formed by means of a so-called "zip" fastener, indicated by 53 and attached along the abutting edges of the sheet parts 25A, 25B.

It is also possible to combine the two embodiments in Figs 8, 9 and Figs 10, 11, by providing a central joint formed as in Figs 10 and 11, with two joints like those in Figs 8 and 9 beside it. This enables the joint to be replaced in case of breakage, without movement of the sheet 25.

The sheet 25 is anchored to the ground, for example by the system illustrated in the enlargement in Fig. 12. The lower edge (parallel to the ground in the assembled state) of the sheet 25 forms a sheath 55 in which is housed a rigid tube 57. The sheath 55 has apertures 59 for the location of stakes 61 or similar ground anchoring members, accompanied by rings 63 into which the tube 57 is inserted.

The system is completed by an assembly indicated generally and schematically by 35, comprising means of monitoring the internal pressure of the tubular members forming the structure and a compressor to maintain the internal pressure of the tubular members at a predetermined value by compensating for any losses or decreases of pressure due to falls in temperature. The various sections into which the pneumatic structure is divided may be accompanied by safety valves 37 which discharge to the outside any excess pressure which may be generated within the pneumatic structure, for example as a result of a rise in temperature.

The bottom sheet 29 and the covering sheet 25 may be coupled together to form a seal. Similarly, the various parts (25A, 25B) into which the covering sheet is divided may be connected (by the fastener means 53) in such a way as to form a seal. It is thus possible to create a slight excess pressure inside the construction, with continuous supply of a limited flow of air if necessary to compensate for leaks, in order to prevent the penetration of toxic gases or bacteriological agents to the interior. This is particularly useful when the construction is used in areas of military operations which are possible theaters of NBC warfare.

The side walls of the structure, and in particular the sheets 25, 27, may have apertures and means of connection to other pneumatic structures, for example tents, which may be used to construct auxiliary environments, for example mechanical workshops and/or laboratories. These apertures may be disposed in the vicinity of the front walls of the structure.

Figs 13 through 15 show a system of wind-bracing of the front walls of the hangar structure. One of the front walls is indicated generally by 90. It is associated with three sets of stays 93, 95 and 97, anchored at one end to the ground S and at the opposite end, by means of a device shown in the sectional detail in Fig. 15, to the front wall. The connection to the front wall is made by means of a vertically extending cylindrical member 98 inserted in a sheath 100 welded to the front wall 90 and extending to a suitable height. The stays 93, 95, and 97 are connected to the sheath 100. 105 indicates a raising stay.

It is to be understood that the drawing shows only an example provided solely as a practical demonstration of the invention, and that this invention may be modified in its forms and dispositions without thereby departing from the scope of the guiding concept of the invention. Any presence of reference numbers in the attached claims has the purpose of facilitating the reading of the claims with reference to the description and to the drawing, and does not restrict the scope of the protection represented by the claims.

Claims

1. A construction in the form of a shed or hangar for the protection and maintenance of aircraft and similar, comprising a pneumatic supporting structure having a plurality of supporting arches (3) consisting of inflatable tubular members connected together by means of connecting members (5).

2. The construction as claimed in claim 1, wherein said connecting members (5) consist of inflatable

tubular members.

3. The construction as claimed in claim 1 or 2, wherein at least one covering sheet (25) and if necessary a thermally insulating sheet (27) are disposed on said supporting structure.

4. The construction as claimed in claim 1, 2, or 3, having external wind-bracing (11, 13; 15, 17) comprising a plurality of guys or stays anchored to the arches (3) and to the ground.

5. The construction as claimed in one or more of the preceding claims, wherein said arches (3) are depressed arches, and said arches are associated with stays or ties (19), in the position of a chord, or parallel thereto.

6. The construction as claimed in claim 5, wherein on the inside of each inflatable tubular member (3) forming an arch and accompanied by a tie (19) there are disposed two internal stays (21), the ends of each of which are anchored to the wall of the tubular member at the points of anchorage of the tie (19) and of a corresponding guy (11) of the wind-bracing, said internal stays transferring the tensile stress from said tie or stay (19) to said guys (11).

7. The construction as claimed in one or more of claims 2 through 6, wherein said tubular connecting members (5) are coupled to the corresponding arches (3) by means of joints (7).

8. The construction as claimed in claim 7, wherein each tubular connecting member (5) is coupled at each end to the corresponding arch (3) by means of a plurality of joints (7), each formed by studs (6, 8) integral with said tubular member (5) and with said arch (3).

9. The construction as claimed in one or more of claims 2 through 8, wherein each of said tubular connecting members (5) is pneumatically connected to at least one of the arches (3) adjacent to it.

10. The construction as claimed in one or more of claims 2 through 9, wherein said supporting structure is divided into sections, each of which comprises one or more supporting arches (3) and the associated tubular connecting members (5), each section being pneumatically independent of the adjacent section or sections.

11. The construction as claimed in one or more of the preceding claims, wherein said supporting structure is associated with at least one safety valve (37) to counter excess internal pressures.

12. The construction as claimed in one or more of the preceding claims, wherein the supporting structure is associated with a system (35) for monitoring and maintaining the internal pressure of the members of the structure, comprising pressure sensing means and compressor means.

13. The construction as claimed in one or more of the preceding claims, wherein said supporting arches (3) are pre-tensioned by stays (24) anchored to the bases of the arches.

14. The construction as claimed in claim 3, wherein said covering sheet (25) is divided into at least two parts (25A, 25B), and means (41-53) are provided for the connection of said parts and for the waterproofing of the joint area.

15. The construction as claimed in claim 14, wherein said means for the connection and for the waterproofing of the joint area comprise a first mechanical connecting member (43; 53) and a pair of strips (43A, 43B), each associated with one of the two parts (25A, 25B) to be connected, and accompanied by means (45, 47; 49) for the reversible connection of said strips (43A, 43B), said strips covering the joint area.

16. The construction as claimed in claim 15, wherein said mechanical connecting member comprises a flexible member in the form of a cable or similar, which passes through eyes (41A, 41B) integral with the two abutting and opposing edges of the sheet parts (25A, 25B) to be connected.

17. The construction as claimed in claim 15, wherein said mechanical connecting member comprises a fastener (53).

18. The construction as claimed in one or more of claims 14 through 17, comprising a drip element (51) extending along the joint area of said two sheet parts (25A, 25B).

19. The construction as claimed in claim 3, wherein said covering sheet (25) has, along the lower edges, a sheath (55) to receive a member (57) for anchorage to the ground.

20. The construction as claimed in one or more of the preceding claims, comprising a bottom sheet (29) with closable apertures.

21. The construction as claimed in one or more of the preceding claims, comprising a set of wind-bracing stays (93, 95, 97) associated with the front

walls (90).

22. The construction as claimed in claim 21, wherein said wind-bracing stays are coupled to the associated wall by means of a tubular sheath (100) containing a rigid cylindrical member (98).

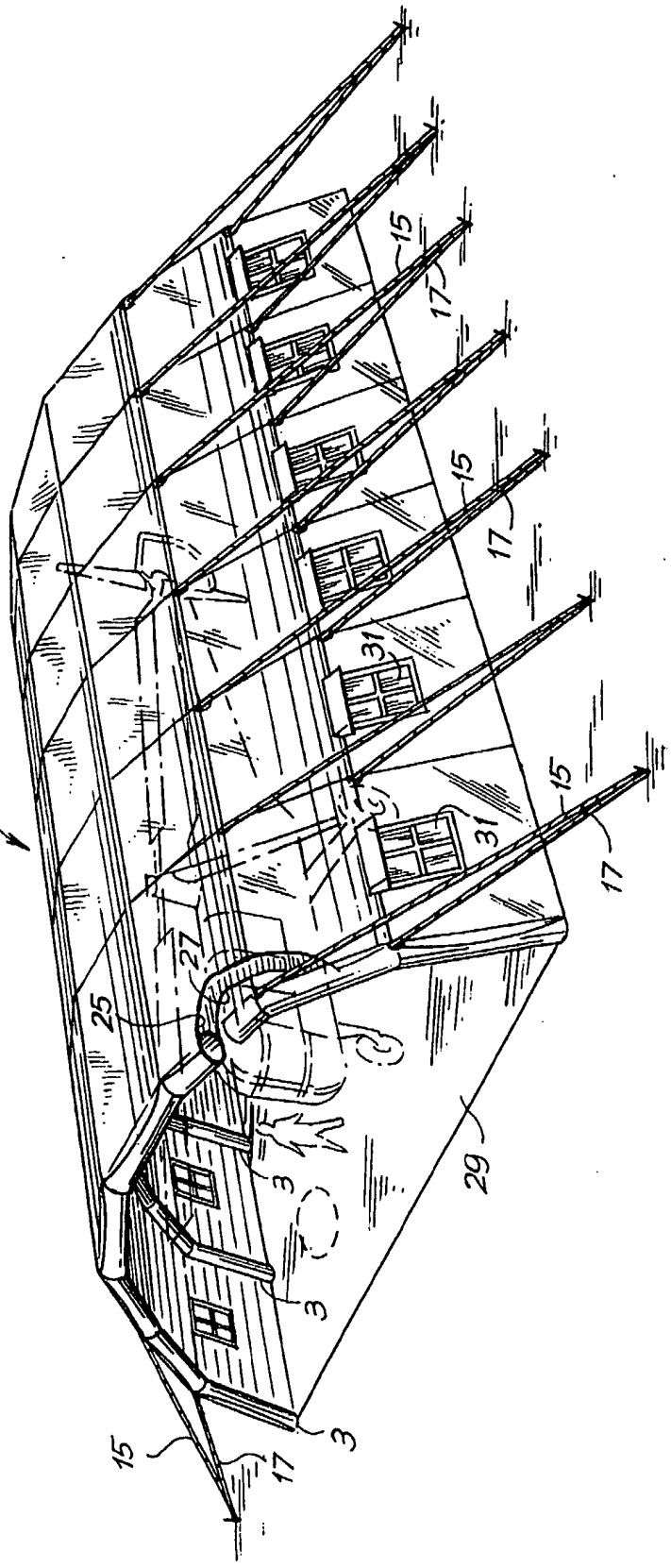


Fig.1

Fig. 2

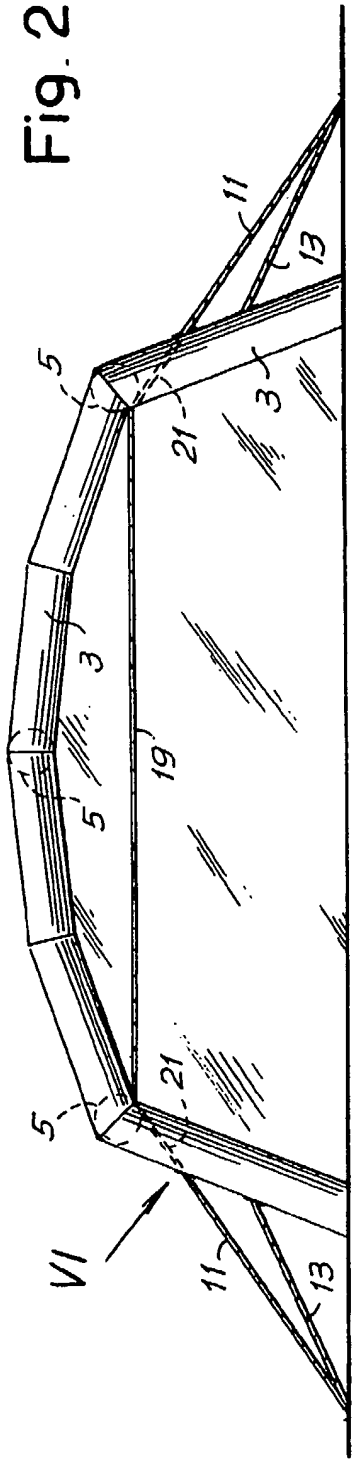


Fig. 3

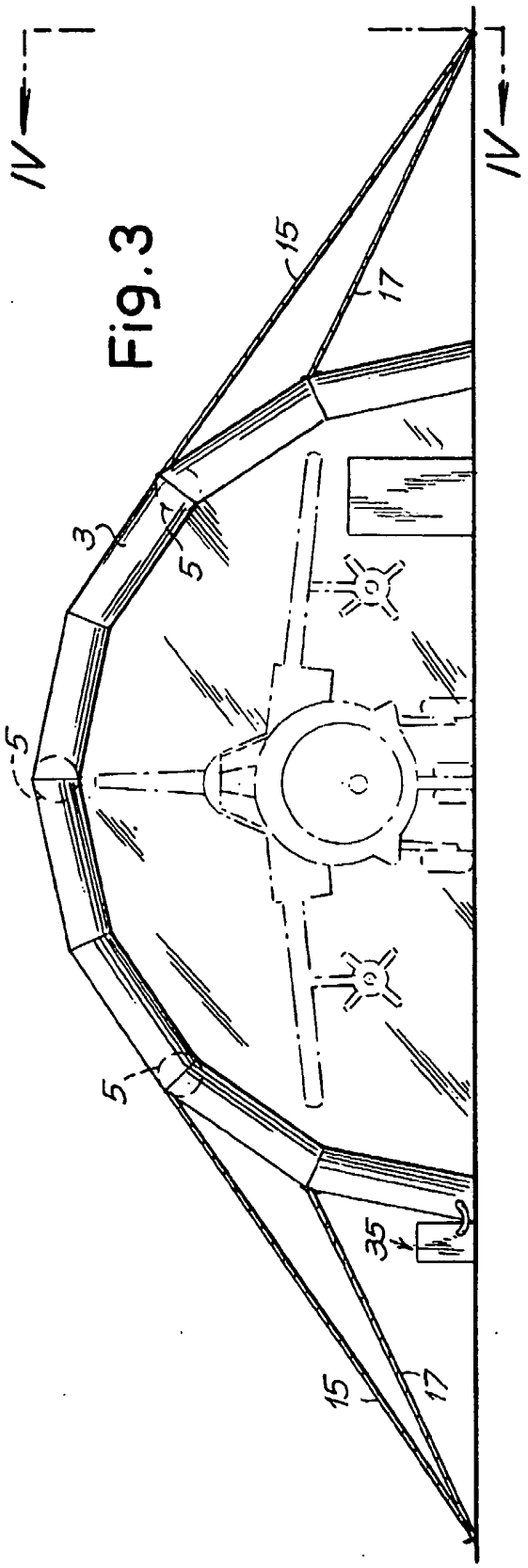


Fig. 4

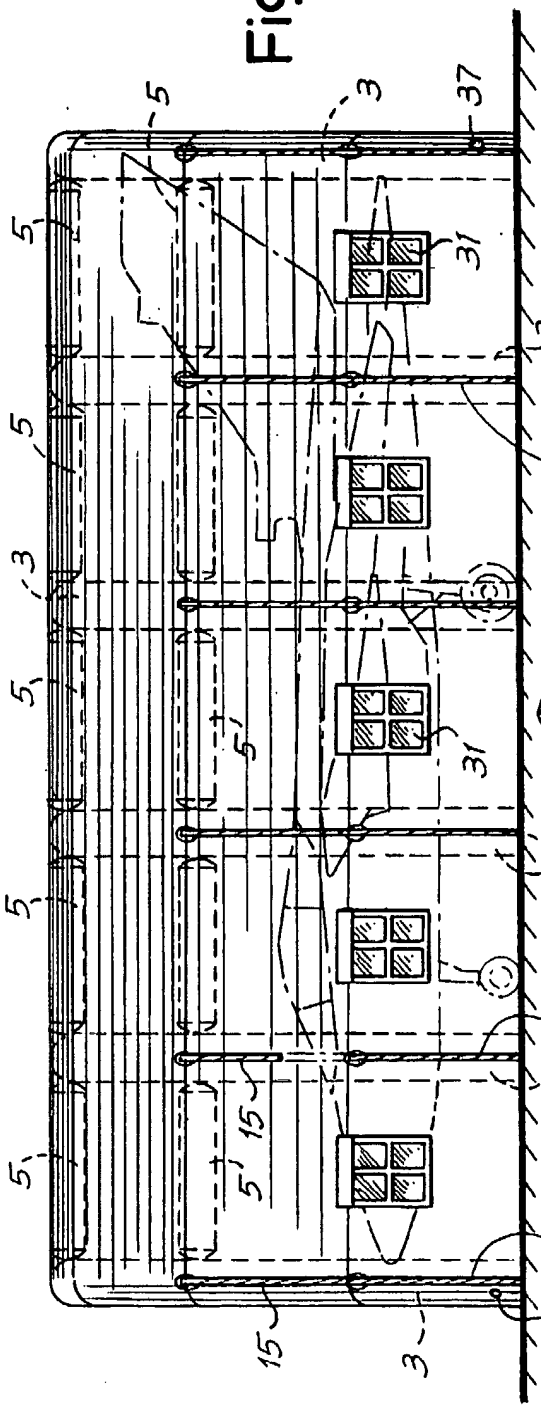
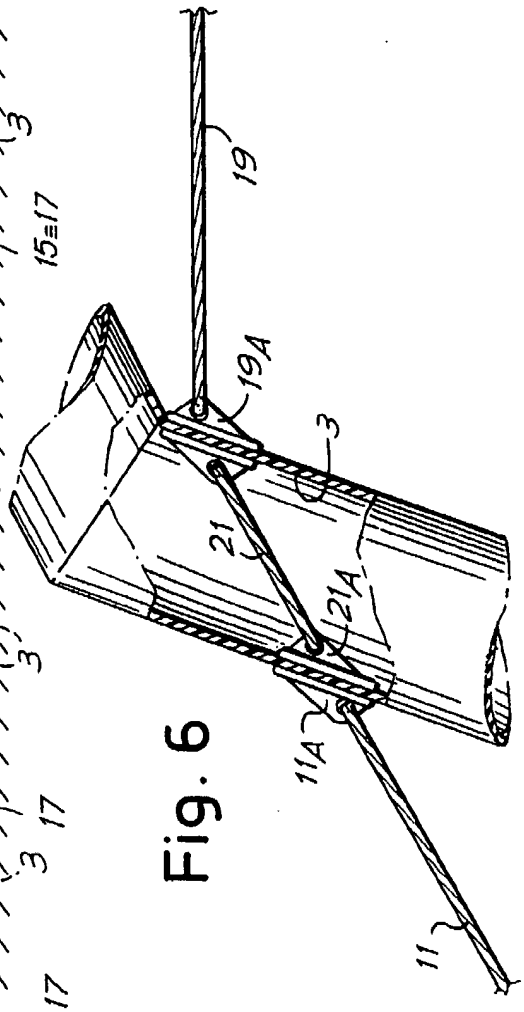


Fig. 6



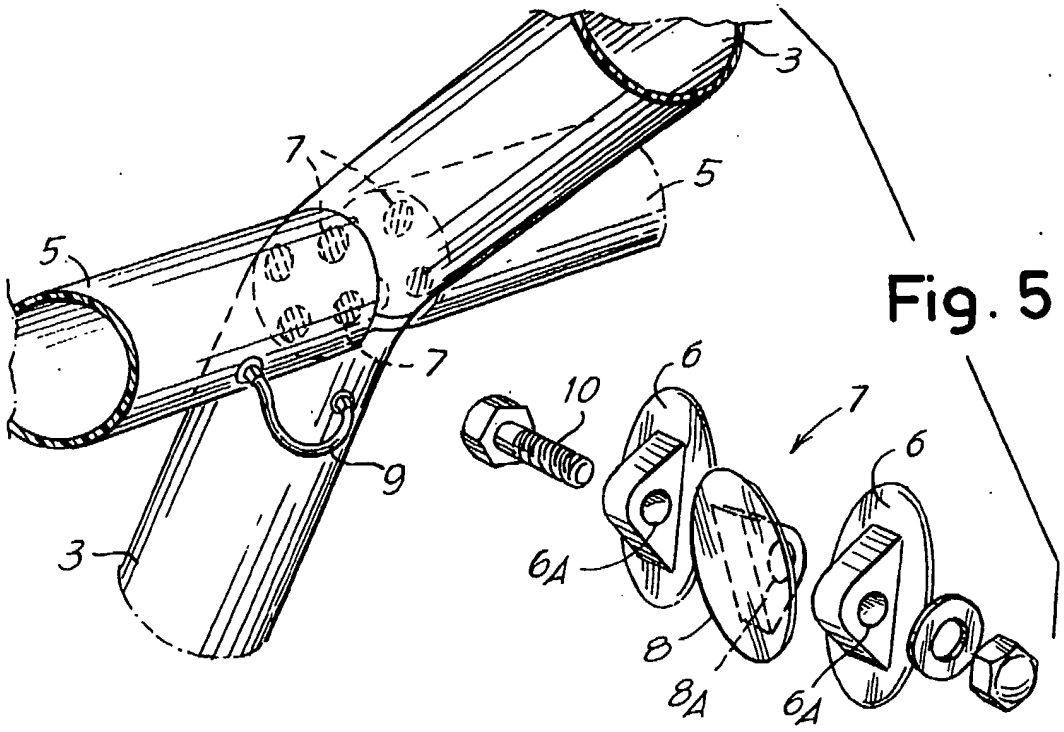


Fig. 5

Fig. 7

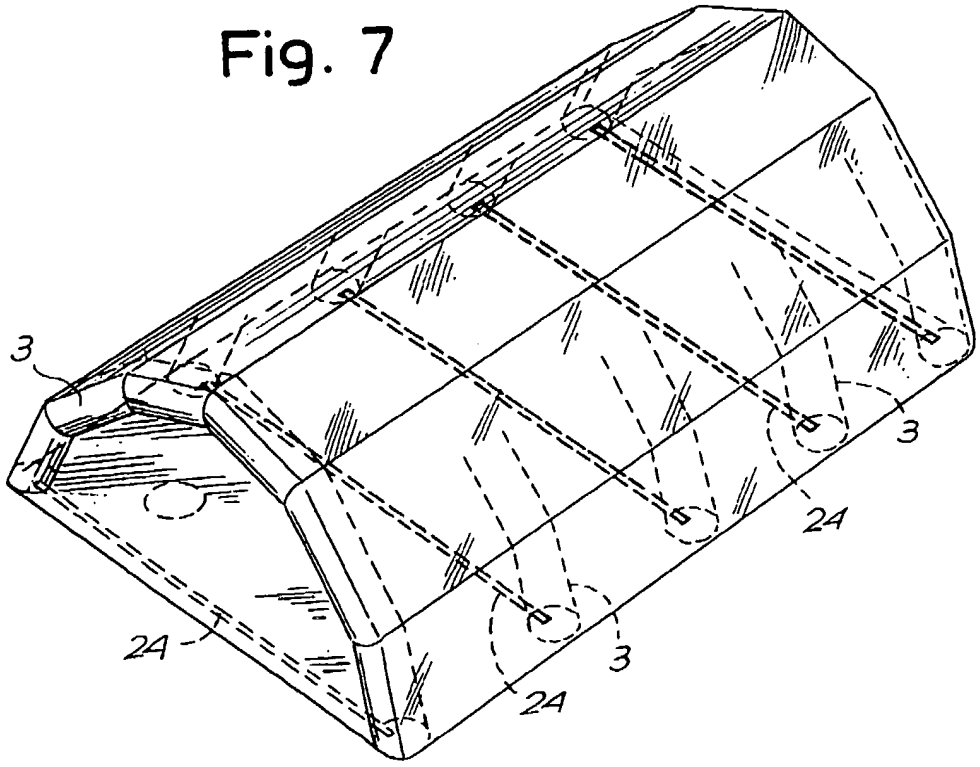


Fig. 8

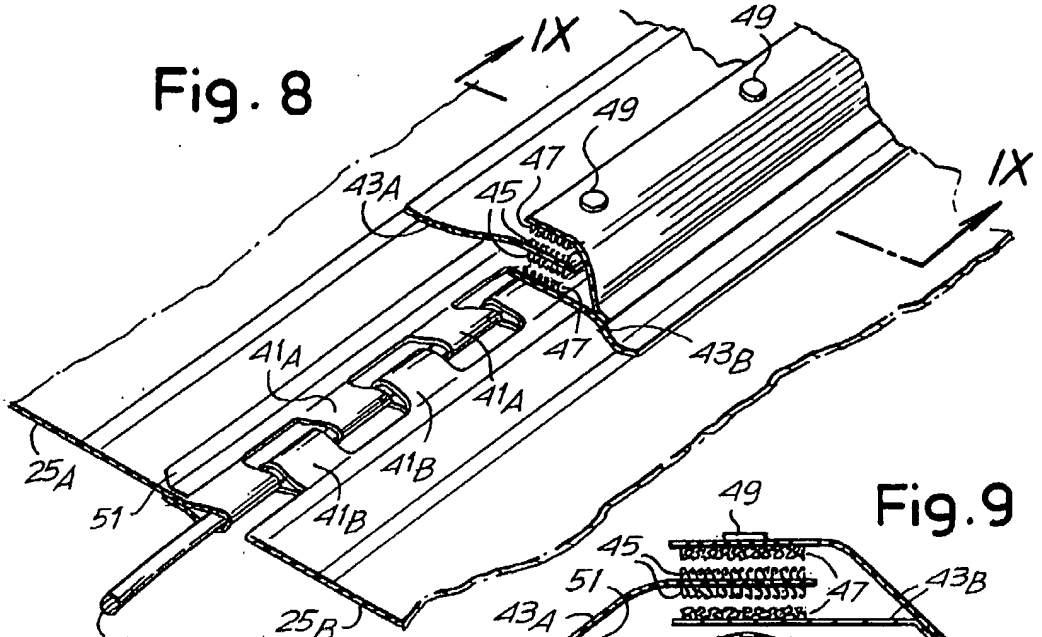


Fig. 9

Fig. 10

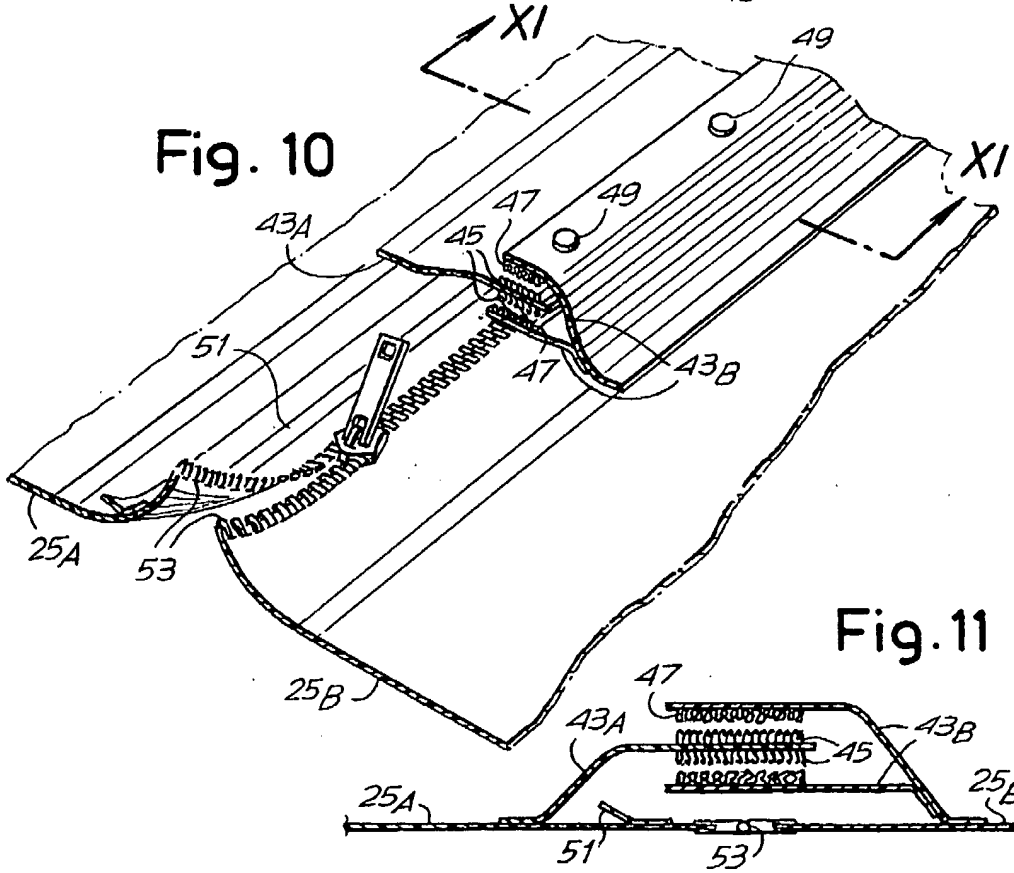


Fig. 11

Fig.12

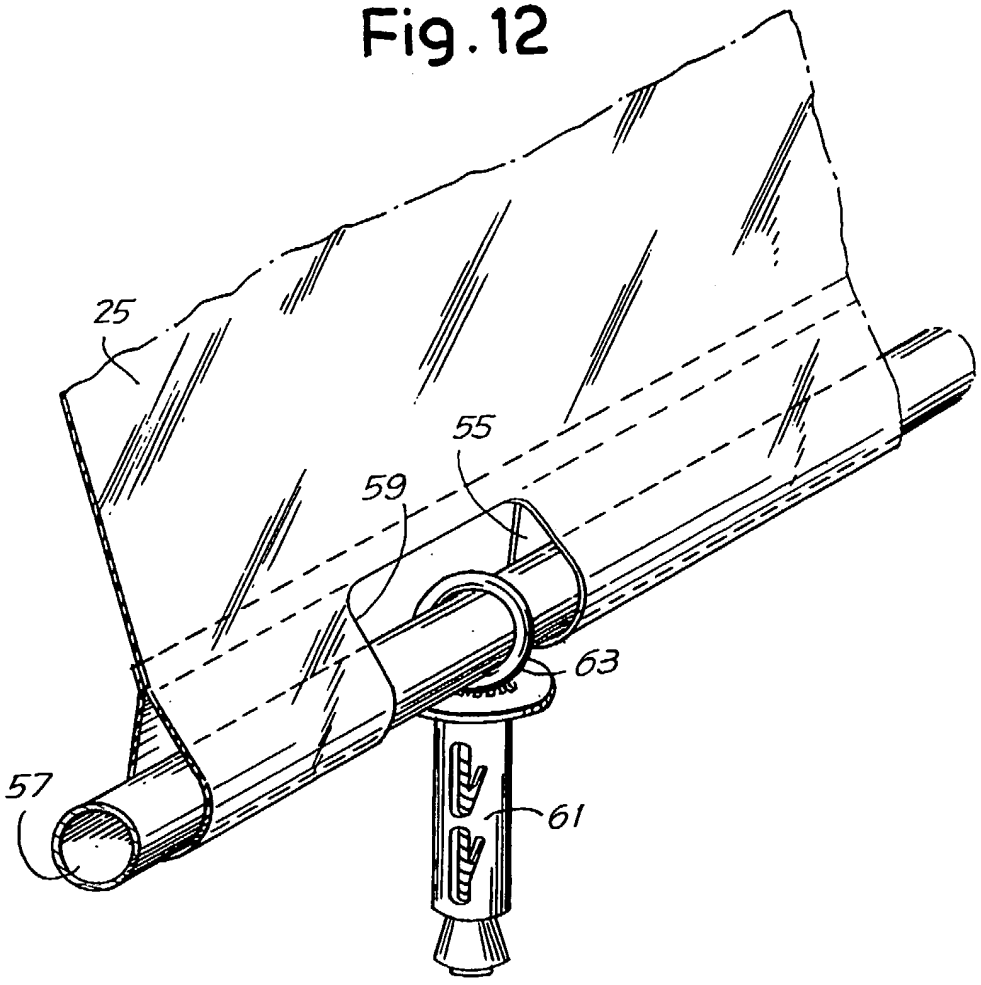


Fig.13

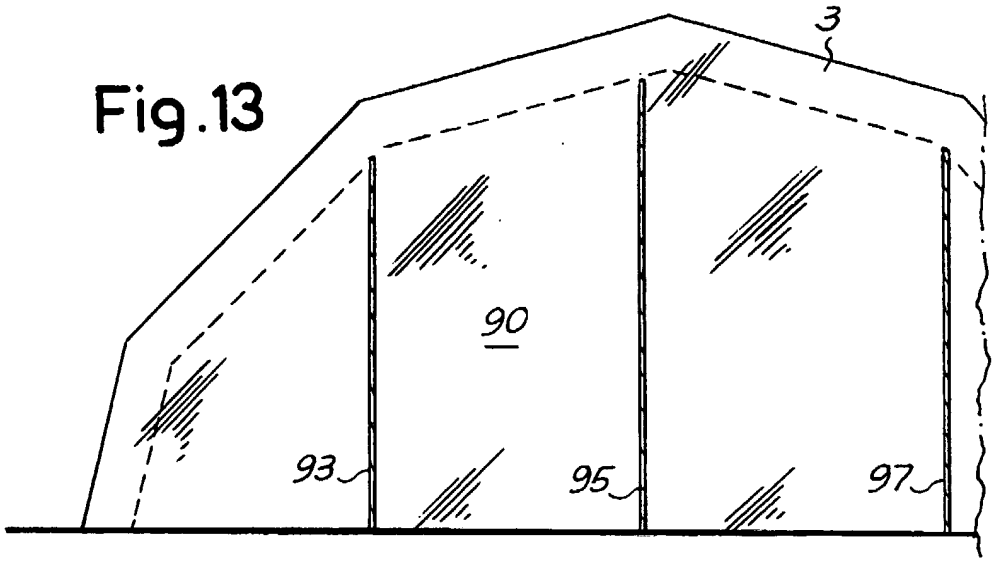


Fig.14

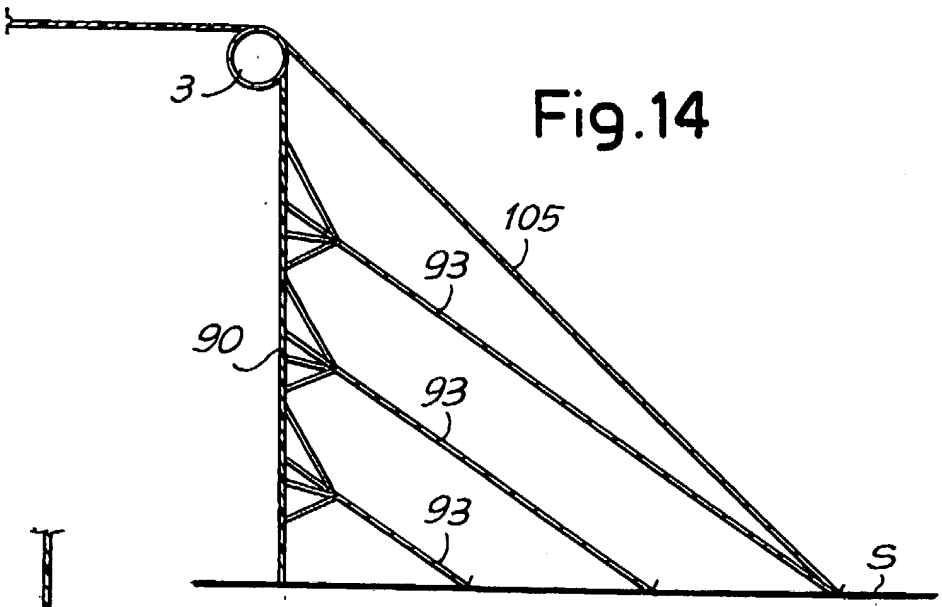
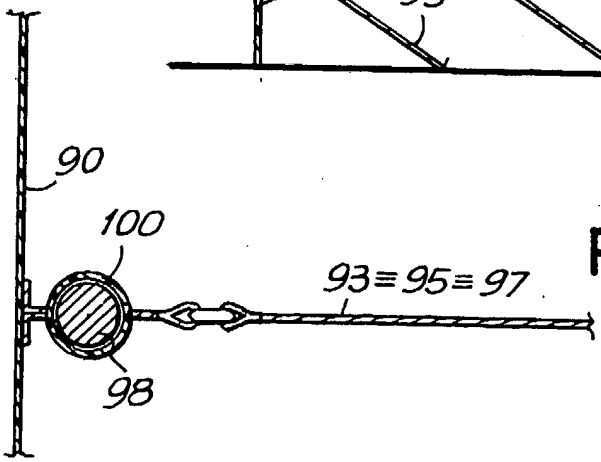


Fig.15



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 83 0578

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	FR-A-865 372 (HARANGER) * the whole document *	1,3-5, 10,21,22	E04H15/20
X	CH-A-438 681 (SCHONENBURG AND CO. AG) * column 2, line 3 - column 3, line 63; figures *	1-3,7,9, 13	
X	US-A-2 591 829 (KATZENMEYER ET AL)	1-4,7,9, 10,14	
Y	* column 3, line 10 - column 9, line 71; figures *	15,16,19	
Y	US-A-3 564 784 (MOLLINGER) * column 2, line 37 - column 4, line 27; figures 1,2 *	15,16	
Y	GB-A-2 008 646 (STEVENS)	19	
A	* page 3, line 15 - line 24 * * page 4, line 5 - line 10; figures 1,2 *	20	
X	WO-A-9 015 208 (STEWKIE LTD)	1-3,7,9, 12	TECHNICAL FIELDS SEARCHED (Int. Cl.5) E04H
Y	* page 3, line 15 - page 18, line 20; figures 1-28 *	8,11	
Y	FR-A-2 422 424 (RIERA ET AL) * claims 1,3; figure 1 *	8	
Y	GB-A-2 190 408 (EARL)	11	
A	* page 2, line 68 - line 126; figures *	12	
A	US-A-2 853 758 (TOPF) * the whole document *	15-17	
A	US-A-2 627 864 (BARKER) * column 2, line 1 - line 37; figures *	20	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 MARCH 1992	FORDHAM A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)